

**A COMPARATIVE STUDY ON THE EFFICACY OF  
CONVENTIONAL EXERCISES VERSUS PILATES IN IMPROVING  
CORE STRENGTH ON LORDOTIC POSTURAL LOW BACK PAIN**

*A dissertation submitted in partial fulfillment of the requirement for the  
degree of*

**MASTER OF PHYSIOTHERAPY**

**ELECTIVE – ADVANCED PT IN ORTHOPAEDICS**



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*(Affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai – 32)*

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**INDIA**

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**ADVISOR**

MRS.L. MAHALAKSHMI; MPT, (Ph.D).,  
ASSOCIATE PROFESSOR  
R.V.S COLLEGE OF PHYSIOTHERAPY  
SULUR, COIMBATORE.

**PRINCIPAL**

MRS. R. NAGARANI SHANMUGHAM; MPT, (Ph.D).,  
R.V.S COLLEGE OF PHYSIOTHERAPY  
SULUR, COIMBATORE.

**SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT  
FOR THE DEGREE OF  
MASTER OF PHYSIOTHERAPY  
AT THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY,  
CHENNAI  
( APRIL 2011)**

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- 1. INTERNAL EXAMINER**
  
  
  
  
  
  
  
  
  
  
- 2. EXTERNAL EXAMINER**

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**CHENNAI**

**(APRIL 2011)**

**DECLARATION**

I hereby declare and present my project work entitled “ **A COMPARATIVE STUDY ON THE EFFICACY OF CONVENTIONAL EXERCISES VERSUS PILATES IN IMPROVING CORE STRENGTH ON LORDOTIC POSTURAL LOW BACK PAIN**”. The outcome of original research was undertaken and carried out under the guidance of **Mrs.L.MAHALAKSHMI, MPT, (PH.D), R.V.S COLLEGE OF PHYSIOTHERAPY, SULUR, COIMBATORE.**

I also declare that the material of the project work has not formed in anyway the basis for the award of any other degree previously from **The Tamil Nadu Dr. M.G.R Medical University, Chennai.**

SIGNATURE

## **ACKNOWLEDGEMENT**

“Thou hast turned for me my mourning into dancing; Thou hast loosed my sackcloth and girded me with gladness; That my soul may sing praise to Thee, and not be silent. **O LORD** my God, I will give thanks to Thee forever.”

I express my sincere gratefulness to **THE CHAIRMAN** and **THE SECRETARY** of **RVS Educational Trust, Sulur, Coimbatore** for providing me the opportunity to continue my higher studies in this institution and carry out the dissertation.

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Finally, I would like to express my heartfelt thanks to **MY FAMILY** and **MY FRIENDS** for their doubtless support and encouragement that enabled me to turn this idea into reality.

## **DEDICATION**

**MY PARENTS:** Thank you for believing in me; and allowing me to further my studies. I am honoured to have you as my parents. Thank you for giving me a chance to prove and improve myself through all my walks of life.

**MY BROTHER:** Hoping that with this research I have proven to you that there is no mountain higher as long as God is in our side. Hope that you will walk again and be able to fulfill your dreams.



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## **ABSTRACT**

### **Purpose of the study**

The purpose of the study was to investigate the efficacy of conventional exercises versus Pilates in improving core strength on lordotic postural low back pain.

### **Materials and method**

30 participants with age group of 40-45, who were diagnosed as lordotic postural low back pain were randomly assigned to receive conventional exercise (Group A = 15) and Pilates (Group B=15). The outcome measures used were Visual Analog Scale for pain and prone abdominal drawing-in test by Pressure Biofeedback Unit for core strength, taken at pre treatment and on the 8<sup>th</sup> week after finishing the rehabilitation protocol. Independent 't' test were performed for measures of VAS and core strength scores of Group A and Group B.

### **Results**

All subjects progressed with a significant decrease in pain and increase in core strength, where the participants in the Pilates group showed more significant improvement in both the variables than conventional group after the session.

### **Conclusion**

Both Conventional and pilates exercises are effective in reducing pain and improving core strength, but pilates showed more efficient outcome than the conventional exercises.

### **Key words**

Lordotic postural low back pain, core strength, conventional exercises, pilates.

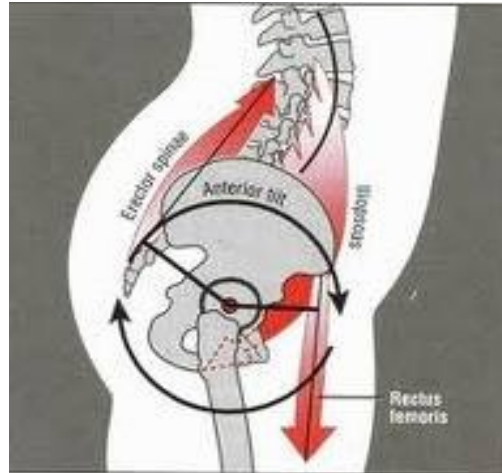
# **1. INTRODUCTION**

Low back pain (LBP) is a very common health care problem affecting 80% of general population. It is the most common reason for sick absenteeism from work and one of the most common conditions for medical consultation. The majority of acute LBP disorders resolved within a four weeks period, although recurrence is common. It is estimated that about 65% of chronic LBP is due to abnormal postures (American Academy of Physical Medicine and Rehabilitation, 2002). For individuals younger than 55 years, postural LBP represents the most common issue of disability and is generally associated with prolonged abnormal postural habits, sedentary life style and work related injuries etc, in which lordotic postural LBP seems to affects large population (Evick D, Yocel A, 2003). The impact of sex on prevalence of lordotic postural LBP has not been established, but it is slightly more frequent incidence in women than in men.

Lumbar lordosis is an exaggerated inward curvature of the lumbar spine(increased lumbo sacral angle) and it is a postural distortion affecting the lower kinetic chain (Lumbopelvic hip complex, knee and ankle). Lordotic type of postural LBP is characterized by chronic pain, muscle imbalance, anterior tilt of pelvis, hip flexion that again exaggerates the lumbar curvature; which leads to L<sub>5</sub>/S<sub>1</sub> soft tissue and joint stress with pain and discomfort, stress to the anterior longitudinal ligament, narrowing of posterior disc space and intervertebral foramen, approximation of articular facets which may cause synovial irritation and joint inflammation. This progresses to instability of sacroiliac joint, piriformis syndrome and anterior knee pain.

The predictable pattern of muscle imbalances most often include the following

<b>WEAK / INHIBITED</b>	<b>TIGHT / FACILITATED</b>
<ul style="list-style-type: none"> <li>• Transverse Abdominis</li> <li>• External and Internal Oblique</li> <li>• Rectus Abdominis</li> <li>• Multifidus</li> <li>• Gluteus Maximus and Medius</li> <li>• Hamstrings</li> </ul>	<ul style="list-style-type: none"> <li>• Iliopsoas</li> <li>• Erector Spinae</li> <li>• Tensor Fascia Lata</li> <li>• Hip Adductors</li> <li>• Rectus Femoris</li> <li>• Gastrocnemius</li> <li>• Soleus</li> </ul>
<b>RESULTING IN</b>	<b>COMMON INJURIES</b>
<ul style="list-style-type: none"> <li>• Anterior rotation of the pelvis</li> <li>• Hips in flexion</li> <li>• Knee may be hyper extended</li> </ul>	<ul style="list-style-type: none"> <li>• Low back pain</li> <li>• Knee pain</li> <li>• Hamstring strains</li> <li>• L<sub>5</sub>-S<sub>1</sub> Instability</li> </ul>



Numerous treatment guidelines have been written regarding the evaluation, treatment and management of lordotic type of postural LBP (Medscape, 2010). Current evidences suggest that factors such as general fitness, co-ordination, proprioceptive awareness & trunk muscles strength and endurance improving spinal stability, focusing on the musculature surrounding the spine, which can be achieved through various types of protocols such as conventional programme, Pilates etc..

Conventional exercise (specific strengthening and stretching) programme is a programme of back exercises designed to teach patients strengthening and flexibility in a pain free range. It not only improves the patient's physical condition and symptoms, but also helps the patient with efficient movement. It provides the movement awareness, knowledge of safe postures, functional strength and co-ordination (Anderson, 2000), that promotes spinal rehabilitation as well as prophylactic care.

Pilates is a unique method of exercise developed by Joseph Pilates (Menezes,2000), which emphasizes the balanced development of the body through core strength, flexibility and awareness in order to support efficient and graceful movements

which helps to overcome back pain and also to correct posture (Stanmore,2002). He consider this to be a body - mind - spirit approach to movement, founded on the integrative effect of principles such as centering, concentration, control, precision, breath, and flow.

This study was intended to investigate whether conventional exercise or pilates training would be effective in reducing patient's self-reported pain and improving activity of deep stabilizing muscles (Transversus abdominis and multifidus), as these muscles become weak in lordotic postural LBP. Strengthening of the core muscles help the patients to get early recovery as well as to prevent the recurrence.

The outcome or results of the treatment techniques given to the lordotic LBP are evaluated by measuring different variables or parameters. The commonly used parameters to assess pain include subjective measures like Visual Analog Scale (VAS), Pain Rating Scale, Mc Gill questionnaire etc. Assessment of core stability includes Plank position test, prone lying abdominal wall drawing-in test by Pressure Biofeedback Unit. The parameters selected for the study are VAS for pain, prone abdomen drawing-in test by Pressure Biofeedback Unit to test deep spinal stabilizers (Transverse Abdominis and Multifidus).

## **1.1 Statement of the problem**

A comparative study on the efficacy of conventional exercises versus pilates in improving core strength on lordotic postural low back pain.

## **1.2 Need for the study**

The management of pain and disability associated with lordotic postural low back pain is challenging in the majority of cases. However the recurrence rate is high after resolution of signs and symptoms spontaneously or with short term pain managements such as NSAID's, physical modalities such as IFT, SWD etc and recurrent disabling episodes remains one of the most costly problems in lordotic postural low back pain.

A deficit in the transverse abdominis and multifidus muscle, which support and stabilize the lumbar spine has been identified in lordotic postural LBP patients and does not resolve spontaneously on resolution of painful symptoms and resumption of normal activity.

Several studies have attempted to compare various exercise regimes without any or minimal difference noted in the effectiveness of treatments in terms of long term pain and core stability. Therefore it would be of interest to determine which type of exercise protocols (Conventional specific strengthening and stretching exercise or Pilates training) would translate into more efficient outcome.

### **1.3 Aim and objectives of the study**

#### **1.3.1 Aim**

The aim of the study was to examine the differential effect of Conventional exercises and Pilates training regime on pain and core muscle strength in patients with lordotic postural low back pain through the parameters, Visual Analog Scale (VAS) for pain assessment and prone abdomen drawing-in test by Pressure Biofeedback Unit for core stability.

#### **1.3.2 Objectives**

- i. To determine the efficacy of conventional exercise on pain relief and core stabilization in patients with lordotic postural LBP.
- ii. To determine the efficacy of pilates exercise on pain relief and core stabilization in patients with lordotic postural LBP.
- iii. To compare the efficacy of conventional exercise and pilates on pain relief and core stabilization in patients with lordotic postural LBP.



## **1.4 Hypothesis**

### **Null Hypothesis**

There is no significant difference between the efficacy of conventional exercises and pilates training in reducing pain and improving core stabilization in patients with lordotic postural LBP, through the parameters of VAS and prone abdominal wall drawing-in test by Pressure Biofeedback Unit.

### **Alternate Hypothesis**

There is a significant difference between the efficacy of conventional exercises and pilates training in reducing pain and improving core stabilization in patients with lordotic postural LBP, through the parameters of VAS and Prone Abdominal wall Drawing-in test by Pressure Biofeedback Unit.

## **1.5 Operational Definitions**

### **1.5.1 Lordotic posture**

Lordotic posture refers to an increase in the lumbo sacral angle (the angle that the superior border of the first sacral vertebral body makes with the horizontal which optimally is 30°).

### **1.5.2 Postural low back pain**

Postural low back pain refers to the low back pain that result from mechanical stress when a person maintains a faulty posture for a prolonged period.

### **1.5.3 Core stability**

Core stability refers to the ability of the core muscles to work in an efficient and coordinated fashion to maintain correct alignment of the spine and pelvis while the limbs are moving. It consists of passive components of the spine, active control by spinal muscles and neuromuscular control or coordination.

### **1.5.4 Core muscle strength**

Core muscle strength is defined by a measurement of the strength of core muscles, either in terms of how much weight or resistance a muscle can lift, how many repetitions a muscle can perform ,or how long a muscle can hold a neutral stable position.

### **1.5.5 Specific stretching**

Specific stretching is a commonly used method of stretching in which soft tissues are elongated just past the point of tissue resistance and then held in that lengthened position.

### **1.5.6 Specific strengthening**

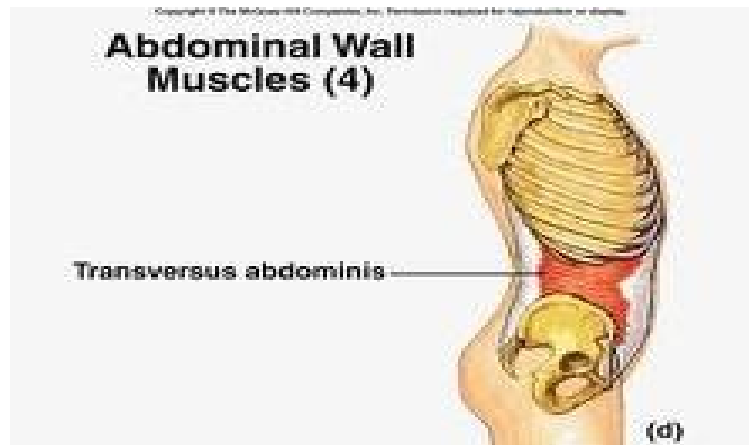
Specific strengthening is defined as a systematic procedure to train a particular muscle or a muscle group by lifting, lowering, or controlling heavy loads (resistance) for a relatively low number of repetitions or over a short period of time.

### **1.5.7 Pilates**

The Pilates method is a body conditioning exercise therapy, targeting the deep postural muscles to achieve core stability (previously mentioned as the ‘power house’ of the spine) and strength with improved muscle balance. It involves the realignment of the spine to its optimum position with gentle stretching and strengthening movements.

### **1.5.8 Transversus abdominis**

It is the deepest of the 6 abdominal muscles. It extends between the ribs and the hips. The transversus abdominis wraps around the centre of the trunk from the front to back. Therefore it contains and supports the organs located there. The fibers of this muscle run horizontally just like a back support belt would be worn.

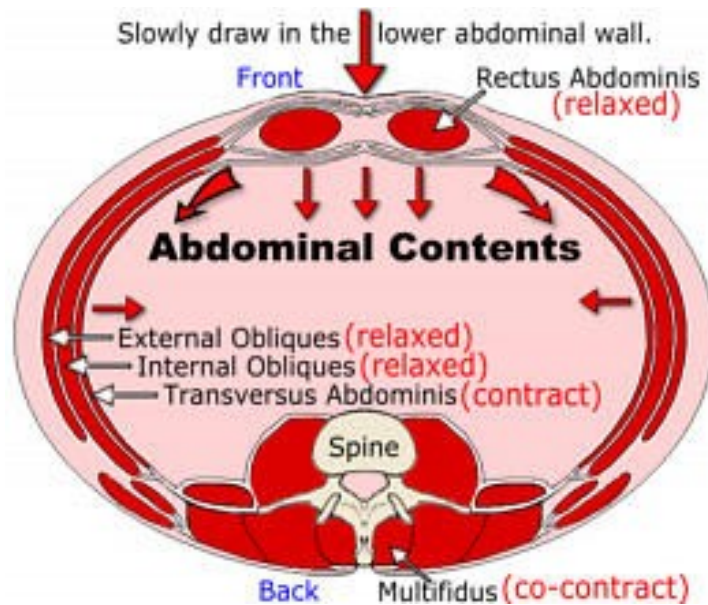


It acts like a girdle to flatten the abdominal wall and compress the abdominal viscera, upper portion helps to decrease the infrasternal angle of the ribs as in expiration, it also contributes to rotation and activates with drawing in maneuver for core spinal stability. The weakness of transversus abdominis results in bulging of the abdominal wall, thereby indirectly tending to affect an increase in lordosis. During flexion in the supine position and hyperextension of the trunk in the prone position, there tends to be a bulging laterally if the transversus abdominis is weak.

#### 1.5.9 Multifidus

It is also a deep muscle of spine and 2<sup>nd</sup> layer of transverse spinalis. It originates from transverse process of L<sub>5</sub> through C<sub>4</sub> and inserted into the spinous process of vertebra above. It stabilizes the spine against flexion and rotation and contralateral side flexion moments, provides core stability and segmental stiffness. It is activated with the abdominal wall drawing in and bracing maneuver for spinal stabilization. It is one of the important muscles among spinal stabilizers, and the weakness results in spinal alignment

distortion.



#### 1.5.10 Pressure biofeedback unit

The Pressure Biofeedback Unit gives valuable information to ensure quality and precision in exercise performance and muscle testing. It allows the clinician and patient to determine if the patient is able to selectively isolate and maintain contractions of the cervical or lumbo pelvic core stabilization muscles. The measuring range is 0-200 mmHg analog pressure with an accuracy of  $\pm 3$  mmHg pressure.

The Pressure Biofeedback Unit designed by physical therapists, is a simple device which registers changing pressure in an air filled pressure cell. This allows body movement, especially spinal movement, to be detected during exercise. The unit consists of a combined gauge/inflation bulb connected to a pressure cell.

## **2. REVIEW OF LITERATURE**

### **1. Fapio Renovato Franca, Thomas Nogueira, Burke (2010)**

Conducted a study on 30 patients with chronic LBP to contrast the efficacy of segmental stabilization (transversus abdominis and multifidus) and strengthening of abdominal and trunk muscles (rectus abdominis, external and internal oblique, erector spinae). The outcome was measured by VAS and Mc Gill Questionnaire for pain, Oswestry Disability Questionnaire for functional disability and Pressure Biofeedback Unit for assessing transverse abdominis strength. After 6 weeks of training, the results concluded that both are effective in relieving pain and to improve transverse abdominis strength but segmental stabilization is superior to superficial strengthening for all variables.

### **2. Pedro Olavo de Paula Lima, Rodrigo Ribeiro de Oliveira, Leonardo Oliveira Pena Costa and Glória Elizabeth Carneiro Laurentino (2010)**

Conducted a study to systematically review studies on the measurement properties of Pressure Biofeedback Units for the assessment of transversus abdominis activity on healthy adults. The studies found moderate to good reproducibility (intra-class correlation coefficients from 0.47 to 0.82) and acceptable construct validity (intra-class correlation coefficients from 0.48 to 0.90).

### **3. Lambeek L.C, Van Mechalan, Knol D.L (2010)**

Conducted a study on 66 patients affected by chronic LBP. He evaluated the

effectiveness of conventional care programme to reduce disability in patients with chronic LBP. By 12 months follow up, these 66 patients had experienced significantly greater improvement in functional status and the condition returned to work.

**4. Duncan.J.Critchley, Zoe Pierson and Battershy (2010)**

Conducted a pilot study on 34 subjects with chronic LBP and they were divided into two groups. One group received conventional exercise programme and the other received Pilates training to strengthen transverse abdominis and obliquus internus. Prone Abdomen Drawing-in test by Pressure Biofeedback Unit was used to measure strength of transverse abdominis and internal oblique. The results concluded that both were effective for strengthen transversus abdominis and internal oblique but pilates training appears to be superior than conventional training to activate transversus abdominis and internal oblique.

**5. RamaprasadMuthukrishnan, Shweta.D.Shenoy, Sandhu.S. Jaspal (2010)**

Conducted a study to examine the differential effect of core stability exercise and conventional physiotherapy regime on 30 patients with chronic LBP. The outcome was measured by Roland Morris Disability Questionnaire, Fear Avoidance Belief Questionnaire, and Chronic Pain Grade Questionnaire. The results concluded that core stability exercise group demonstrated significant improvement than the conventional physiotherapy regime.

**6. NitiRajpal, Manish Arora, VivekChautan (2009)**

Conducted a study on 40 patients with postural low back pain aged between 20 and 30 years on efficacy of pilates and pilates and McKenzie exercises in postural LBP. Outcome measures were prone abdominal drawing in test by sphygmomanometer for core strength, Back Performance Scale for flexibility, Digital Inclinator for standing pelvic tilt angle, VAS for pain. The results concluded that there was a significant improvement in core strength and VAS in both the groups as compared to standing pelvic tilt angle and back performance scale score. Therefore pilates training was found to be

effective to improve core strength and reduce pain.

**7. Boonstra, Anne.M, SchiphorstPreuper (2008)**

Conducted a study to determine the reliability and validity of VAS in chronic musculoskeletal pain aged over 18 years. The study population consisted of 52 patients in the reliability study and 344 patients in the validity study. The conclusion of the study was that the reliability of VAS is moderate to good and its validity is questionable.

**8. KaulRohini, ThakralGaurav, SandhuJaspal (2008)**

Conducted a study on 11 subjects with chronic LBP to compare the effects of specific lumbar stabilization and conventional back extension exercises. The outcomes were measured by utilizing barobag test in prone abdominal drawing in and single leg slide test to assess core stability. The results concluded that specific lumbar stabilization exercise showed significant improvement than the conventional exercise.

**9. Susan Sorosky, Sonja Stilp, VenuAkuthoti (2007)**

Conducted a study on 52 patients with nonspecific LBP. They were given yoga and pilates exercise. The outcome was measured by VAS, Oswestry Low Back Pain Disability Questionnaire. The participants in the pilates group reported a better subjective response to treatment as compared to those in the yoga group.

**10. T Rowland; and V Sparkes (2007)**

Conducted a study aimed to determine the intra, inter and test re-test reliability of the Pressure Biofeedback Unit. 3 raters and 10 subjects were recruited fulfilling specific inclusion criteria. Following a period of training in the abdominal drawing-in test each subject was assessed in a randomized order during one visit by all three raters. All raters and subjects were blind to the result of previous attempts. All subjects were assessed on a second visit a week later by one rater. ICC's were calculated to determine intra, inter and test re test reliability. Based on the results, they concluded that the Pressure Biofeedback



Unit is a reliable tool when utilised with a population of subjects that can perform the abdominal drawing-in test.

**11. Rydeard.R, Leger.A, Smith.D (2006)**

Conducted a randomized controlled trial on 39 physically active subjects between 20 and 55 years old with chronic LBP. They were divided into 2 groups. One group received pilates training while the control group received usual care defined as consultation with a physician and other health care professionals as necessary. Functional disability outcomes are measured with the Roland Morris Disability Questionnaire and the average pain intensity using a 101 Point Numerical Rating Scale. The results concluded that pilates training group reported a significant decrease in LBP and disability which was maintained over a 12 months follow up period than the control group.

**12. Slade.S.E et al (2006)**

Conducted a study on 30 patients with chronic LBP to compare the effectiveness of strengthening exercise and aerobic exercise for chronic LBP. The study concluded that trunk strengthening exercise showed a beneficial results than the aerobic exercise group in terms of pain, which was measured by VAS.

**13. Carolyn.F.Watson (2006)**

Conducted a study on 11 patients with chronic LBP to find out the reliability of prone abdominal drawing in test by utilizing Pressure Biofeedback Unit to assess the strength of transversus abdominis. The conclusion of the study was that the reliability of this test is moderate to good and can be used to assess the strength of tranversus abdominis.

**14. Lisa Marie Bernardo (2006)**

Conducted a study on 39 healthy subjects to find out the effectiveness of pilates training utilizing a true experimental design and concluded that the pilates training can strengthen and improve spinal stabilization in healthy adults.

**15. Donzelli et al (2006)**

Conducted a randomized controlled study on LBP to find out the effective rehabilitative protocol between pilates and back school method for LBP. The study concluded that the pilates technique is more effective than back school method in the management of LBP.

**16. Gagnon, Laura Itorvath (2005)**

Conducted a study to investigate the efficacy of pilates training as a therapeutic intervention in treatment of LBP at the university of Tennessee. 12 patients were selected and divided 2 groups with 6 subjects in each group. One group received Pilates and other group received traditional lumbar stabilization exercises. VAS for pain, the revised Oswestry Disability Index, lumbar spine active range of motion and Stability Platform Apparatus for core stability was used to measure the outcome of the study. The study concluded that pilates is an legitimate and safe exercise and can be performed as an therapeutic intervention with patients who have LBP.

**17. Le Harrington et al (2005)**

Conducted a study on the influence of pilates training and the ability to contract the transverse abdominis muscle in asymptomatic individuals. The study concluded that pilates could contract transverse abdominis and maintain better lumbo pelvic control.

**18. Olaogun, Matthew, Adeyoin, Rufus (2004)**

Conducted a study to determine the intra class and inter class correlation of VAS and Semantic Differential Scale (SDS) in patients with LBP. 25 patients with chronic LBP were selected for the study. Two testers independently rated the pain experienced by the patients when asked to bend forward and hold on when pain was either exacerbated or aggravated. Fingers to floor test was taken, as a measure of flexion of the spine for each patient. Pain was rated using VAS and SDS. The results suggested that the two scales are reliable and valid for clinical rating of LBP.

**19. Eileen. L. DiGiovanna, Stanley Schiowitz, Dennis. J. Dowling (2004)**

They concluded that the lumbosacral angle formed in the upright position, from a side view, by extending the line of inclination of the sacrum as it meets a line parallel to the ground. This angle is normally between 25 to 35 degrees. The major portion of the low back pain is attributable to an increased lumbosacral angle. In addition, the increased angle increases the lumbar lordosis.

**20. Ludmilla et al (2003)**

Conducted a study on effect of physio ball exercise and conventional back exercise on back and abdominal core stability on 38 patients with chronic LBP. The study concluded that both types of exercises resulted in greater gains in core stability which was proven by using EMG neuronal activity.

**21. Kjersti Storheim (2002)**

Conducted a study on 15 subjects with LBP to find out the reliability of prone abdominal drawing in test by Pressure Biofeedback Unit to measure the strength, co-ordination and timing of transverse abdominal contraction. The results concluded that prone abdominal drawing in test by Pressure Biofeedback Unit is a reliable and valid

measure to assess the strength of transversus abdominis.

**22. Day (2001)**

Conducted a study on 20 patients with chronic LBP to find out the correlation between pelvic tilt on standing posture and LBP. The outcome was measured by digital inclinometer to assess the anterior pelvic tilt. The study concluded that anterior pelvic tilt cause an increased in the depth of the anterior curvature and thereby increase the risk of chronic LBP.

**23. Julie.A.Hieds, Carolyn.A.Richardson (2001)**

Conducted a study on long term effects of specific stabilization exercises for LBP on 60 patients. The outcome were measured by Mc Gill pain questionnaire and Visual Analog Scale for pain, Roland Morris Disability Index for disability, Inclinometer for ROM, Ultrasound imaging for muscle cross section area. The results concluded that specific exercise therapy had a beneficial effects and successful long term management of LBP.

**24. Walker.M.L et al (2000)**

Conducted a study to assess the relationship between lumbar lordosis, pelvic tilt and abdominal muscle performance. The outcome was measured by using an inclinometer to determine the angle formed with the horizontal line drawn between the ASIS and PSIS. The study concluded that there was a strong correlation between lumbar lordosis, anterior pelvic tilt and poor abdominal muscle performance.

**25. Mindy C Cairns, Karen Harrison and Chris Wright (1998)**

Pressure biofeedback is a tool designed to facilitate muscle re-education by detecting movement of the lumbar spine associated with a deep abdominal contraction in relation to an air-filled reservoir. Pressure biofeedback readings of an abdominal 'drawing-in' maneuver, designed to recruit the deep abdominal muscles, were taken from

45 patients. They were classified into three groups: lumbar symptomatic, non-symptomatic, and those who had previously had lumbar symptoms that had now resolved. Subjects were taught an abdominal drawing-in maneuver and the mean of three readings using the prone test was calculated. Comparison between groups using an unrelated ANOVA demonstrated a statistically significant difference between the lumbar symptomatic and non-symptomatic groups at the  $p < 0.05$  level. The findings of this study provide evidence to support previous research, which indicates that a difference exists in the deep abdominal function of patients with and without low back pain. Additionally it is suggested that the Pressure Biofeedback Unit may be considered as a useful tool to act as an indicator of deep abdominal function.

### **3. METHODOLOGY**

#### **3.1 Research Design**

Experimental design, comparative in nature.

#### **3.2 Variables**

##### **3.2.1 Independent variables**

- Conventional exercises.
- Pilates exercises.

##### **3.2.2 Dependent variables**

- Lordotic postural low back pain.
- Core strength

#### **3.3 Study Setting**

The study was conducted at Department of Physiotherapy and rehabilitation, Back Pain Clinic, Mother care hospital, Palakkad with consultation of concerned authority.

#### **3.4 Study Sampling**

For this study, 30 patients with LBP diagnosed as having lordotic posture were selected by purposive sampling technique. They were divided into two groups: - Group A

and Group B, with fifteen subjects in each group.

### **3.5 Criteria for selection**

#### **3.5.1 Inclusion Criteria**

- Gender ;- females only
- Age group ;- 40 to 45 years
- Patients with lordotic postural LBP for more than 3 months
- Subjects with lumbo sacral angle greater than 35°.
- Pain rating on VAS less than 6

#### **3.5.2 Exclusion criteria**

- Acute LBP
- Subjects having sciatica or any other neurological deficit
- Subjects having soft tissue injuries like acute inter vertebral disc prolapse
- Subjects with previous or recent spinal fractures and surgeries
- Structural deformities and congenital anomalies of spine
- Extremely obese subjects (Body Mass Index more than 28)
- Infections or tumors of spine

- Athletes
- Patients with Rheumatological disorder
- Subjects who have participated in activities which utilizes breathing patterns similar to pilates such as yoga, martial arts etc
- Orthopaedic impairments of upper limb or lower limb.
- Peripheral Vascular Disease.
- Any respiratory or cardiovascular impairment.
- Abdominal or limb surgery within the past 12 months.

### 3.6 Study Duration

8 weeks (30 – 40 minutes, 5 sessions weekly)

### 3.7 Measurement Tools

#### 1. Visual analog scale

VAS consists of a 10 cm horizontal line with 2 end points. One end was labeled as ‘no pain’ and other end was labeled as ‘severe pain’. The patients were required to place a mark on the 10 cm line at a point which corresponds to the level of pain intensity that the patient felt.





## **2. Prone abdominal wall drawing –in test by Pressure Biofeedback Unit**

It is a non-invasive clinical test utilizing the Pressure Biofeedback Unit to assess the function of transverse abdominis as well as whether the contraction can be performed in isolation of other abdominal muscles. This test is easy and inexpensive to administer.

The test is executed with the subject lying prone, on a flat hard surface. The pressure cuff unit of the Pressure Biofeedback Unit is inflated under the abdomen, conforming to the patient's shape. The cuff is placed underneath the abdomen, with the navel centered. The distal edge of the pad should be in line with the left and right anterior superior iliac spine. The cuff is initially inflated to 70mmHg and allows stabilizing while the subject breathed normally. The subject relaxes the arms to the sides for the duration of the test. Once the needle remains steady at 70mmHg, the subject is verbally cued to breathe in and out normally and then without inhaling, to slowly raise the abdomen away from the pad, without any shift in the spine.

The testing device has a range of 0-300 mm Hg in 2 mmHg interval, which is marked as a small line instead of numerical, so any score in between the line was recorded in odd numbers (for example any test trial shows score in between 64 mmHg and 66 mmHg was recorded as 5), only numbers divided by 20 is given in the dial.

- Each subject received one practice contraction before the tested contraction.
- The subject was instructed to hold the contraction for 10 seconds and the drop in 'mmHg' was recorded.
- Repeated the contraction for 3 times.

- After each contraction, the subject was instructed to resume a normal, relaxed breathing pattern.
  - No feedback was given regarding the success or failure to initiate a proper contraction during the test.
  - The test was designed to take approximately 15 minutes.
  - The best score of the three recorded contractions was taken for data analysis.
  - Correct engagement of the transverse abdominis resulted in a negative pressure drop and the absolute value of the drop was recorded.
  - An increase in pressure indicates that the subject is substituting contraction of external obliquus or rectus abdominis for transvers abdominis.
  - No drop in pressure or a drop of 2 mmHg in pressure during the prone abdominal drawing in test indicates the subject is unable to contract the transversus abdominis independent of other abdominal muscle
  - A drop of pressure in the dial about 10 units is considered as normal.
  - For instance, a successful drop of 10mmHg was recorded as a score of 10.
- Any test trail resulting in a rise in mmHg (1 or higher) is recorded as '0' since elevation in mmHg during the prone test signifies an inability to successfully isolate and contract the transversus abdominis (contraction of rectus abdominis).

### **3.8 Materials**

- Couch

- Chair
- Pillow
- Pencil
- Chart
- Pressure Biofeedback Unit (Zabesta-XLO)
- Mat
- Swiss ball
- Thera band
- Weight cuff
- Ball

## **1.9 Procedure**

The study population consisted of 30 females, who were diagnosed by orthopaedician as postural LBP with increased lumbosacral angle beyond  $35^{\circ}$  by using

lateral view of x-ray, beside all these patients were further examined by routine physiotherapy assessment and confirmed that the postural LBP is due to exaggerated lumbar lordosis and suitable for inclusion criteria were reputed by non-probability sampling technique.

The complete details of the procedures and possible benefits of participation in the study were explained before informed consent was obtained. They were asked to inform if they feel any discomfort during the exercise programme. Permission to perform this study was granted from the HOD, Department of Physiotherapy and rehabilitation.

The 30 subjects were divided into Group A and Group B with 15 in each. Prior to the treatment, pretest was conducted for group A and group B on pain and core strength through the parameters VAS and prone abdominal drawing in test by Pressure Biofeedback Unit respectively and the scores were recorded.

After a brief demonstration to group A subjects about conventional exercise, which involves strengthening of abdominals and glutei muscles and stretching of hip flexors and lumbar spine extensors, they were subjected to the above mentioned protocol for a duration of 8 weeks, 5 sessions weekly.

After a brief demonstration to group B subjects about pilates training, they were subjected to pilates training for a period of 8 weeks, 5 sessions weekly. After 8 weeks of programme, the post test was conducted for both groups on pain and core strength through the parameters of VAS and prone abdominal drawing in test by Pressure Biofeedback Unit and the scores were recorded to compare with pretest scores.

## 4. OBSERVATION AND ANALYSIS

### 4.1 Statistical Analysis

The statistical tools used in the study were paired 't' test and unpaired 't' test.

#### Paired 't' test

The paired 't' test was used to find out the statistical significance between pre and post test of patients treated with conventional exercise programme and pilates programme separately.

#### Formula –Paired 't' test

$$\text{'t' calculated value} = \frac{\bar{d}}{SE}$$

$$\bar{d} = \frac{\sum d}{n}$$

$$SE = \frac{S}{\sqrt{n}}$$

$$S = \sqrt{\frac{\sum (d - \bar{d})^2}{n-1}}$$

Where, d = difference between pre test and post test values.

n = number of subjects

$\bar{d}$  = mean difference (average of the difference in values

Between pretest and post test)

SE = Standard Error

S = Standard deviation

### Unpaired 't' test

The unpaired 't' test was used to compare the statistically significant difference Between Group A and Group B.

### Formula – Unpaired 't' test

$$\text{'t' calculated value} = \frac{|\bar{x}_1 - \bar{x}_2|}{SE}$$

$$E = S \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

$$S = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Where,  $\bar{x}_1$  = mean difference between pre and post test of group A

$\bar{x}_2$  = mean difference between pre and post test of group B

$n_1$  = total number of subjects in group A

$n_2$  = total number of subjects in group B

$s_1$  = standard deviation for group A

$s_2$  = standard deviation for group B

SE = Standard Error

S = Standard deviation

#### 4.2 Data Presentation

A total of 30 patients, 15 in each experimental group (Group A and Group B) selected for the study. The data collected were tabulated for easier statistical calculation and better comprehension.

##### Experimental Group A

##### Conventional exercise

**Table 1**

Sl.No	Pain		Core Strength(mmHg)	
	Pre test	Post test	Pre test	Post test
1	4	1	6	12
2	5	2	0	4
3	4	2	6	8

4	5	1	2	4
5	5	2	0	8
6	5	4	2	6
7	6	2	4	6
8	4	1	6	11
9	3	0	2	6
10	4	2	5	10
11	5	2	2	4
12	3	1	1	6
13	6	4	4	4
14	6	3	5	9
15	5	3	2	7

## Experimental Group B

### Pilates exercise

Table 2

S.No	Pain		Core Strength(mmHg)	
	Pre test	Post test	Pre test	Post test
1	5	1	2	9
2	5	0	5	11
3	5	1	1	10
4	4	0	6	12
5	5	2	3	11



6	4	2	5	10
7	3	0	1	8
8	6	1	4	10
9	4	0	0	11
10	3	0	4	7
11	5	3	3	10
12	6	2	2	11
13	5	0	5	10
14	6	2	0	8
15	4	1	6	12

### 4.3 Data Analysis and Interpretation

This section deals with the analysis and interpretation of data collected from experimental groups, Group A and Group B, who underwent conventional exercise and Pilates respectively.

**Table 3**

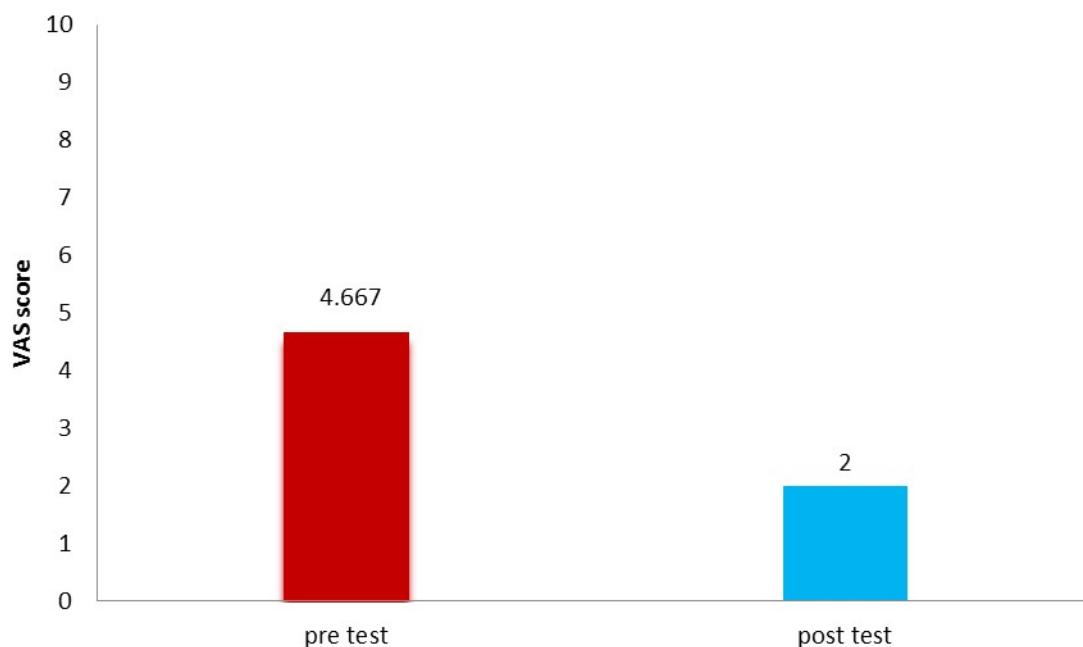
#### **Experimental Group A**

Table 3 represents the mean values, mean difference, standard deviation and paired 't' calculated value between pre test and post test values of VAS score for group A, who have been subjected to conventional training.

<b>VAS score</b>	<b>Mean</b>	<b>Mean difference</b>	<b>Standard deviation</b>	<b>Paired 't' calculated value</b>
Pre test	4.667	2.667	.817	12.6496
Post test	2			

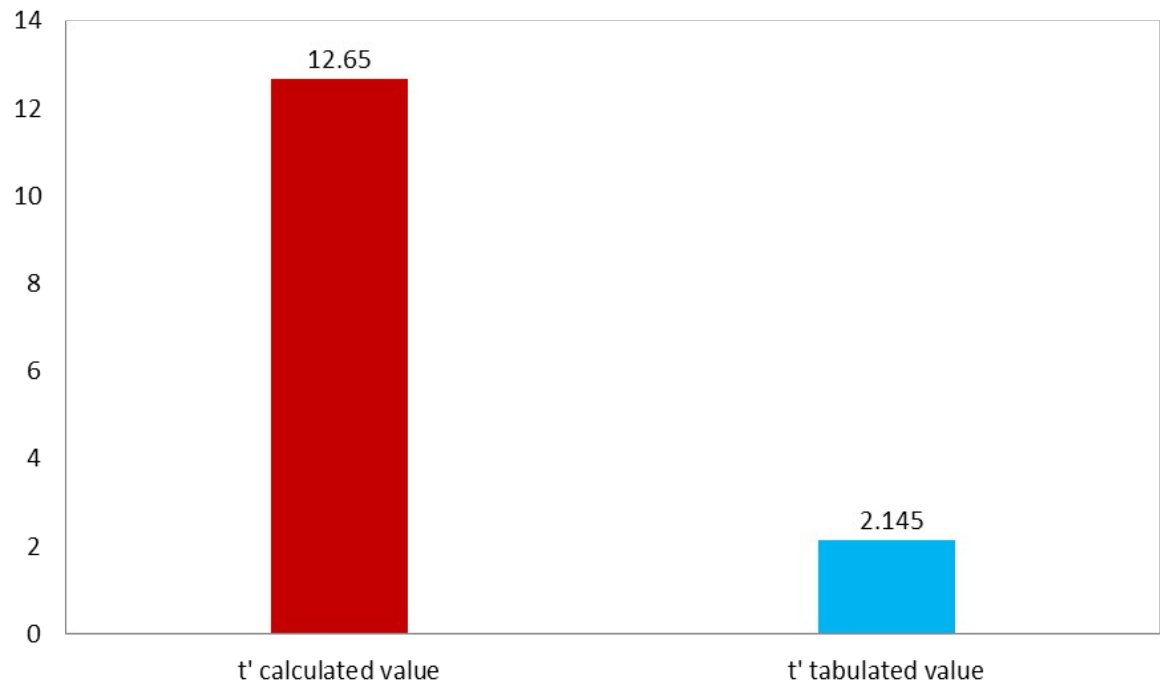
Table 2 shows the analysis of VAS score: - the paired 't' calculated value of pre versus post test of group A was 12.6496, which was greater than the tabulated paired 't' value of 2.145 for (n-1) degrees of freedom at 5% level of significance for group A. This shows that there was a statistical significant difference in between pre versus post test results. The pre test mean was 4.667 and the post test mean was 2.0 and the mean was 2.667, which showed that there was reduction in VAS score in post test values, that shows the recovery of selected samples in response to intervention.

#### **VAS score of Group A**



**Graph -1**

**Paired 't' calculated and 't' tabulated value-Group A ( VAS score)**



**Graph - 2**

**Table 4**

**Experimental Group B**

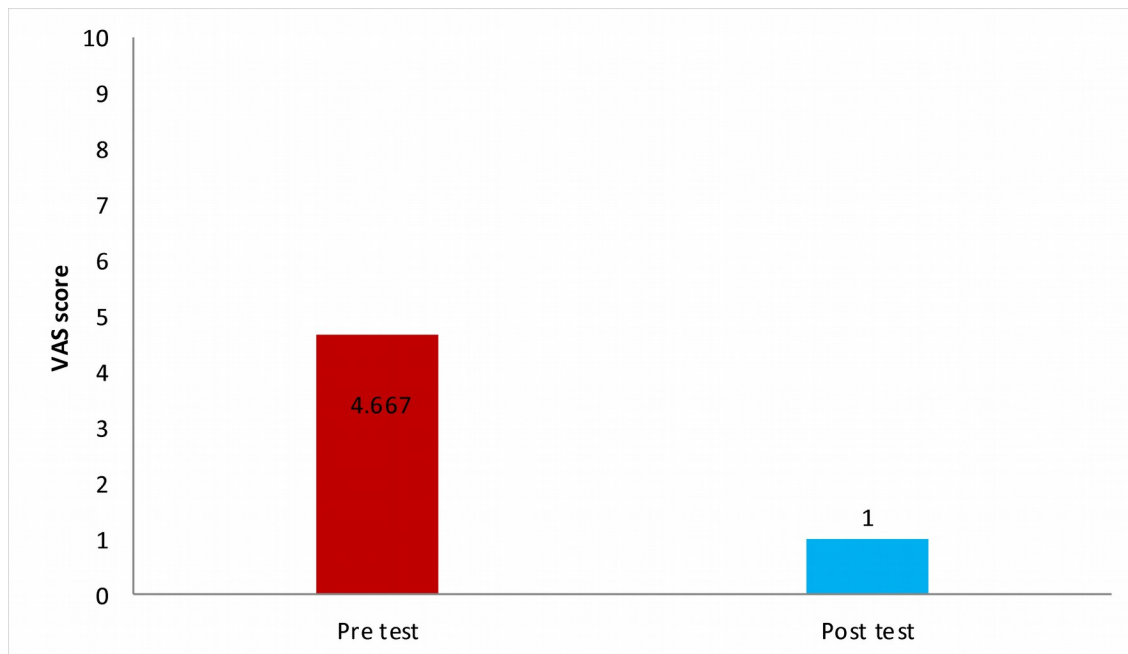
Table 4 represents the mean values, mean difference, standard deviation and paired 't' calculated value between pre test and post test values of VAS score for group B, who have been subjected to pilates training.

VAS score	Mean	Mean difference	Standard deviation	Paired 't' calculated value
Pre test	4.667	3.667	.964	14.7378
Post test	1			

Table 4 shows the analysis of VAS score :- the paired 't' calculated value of pre

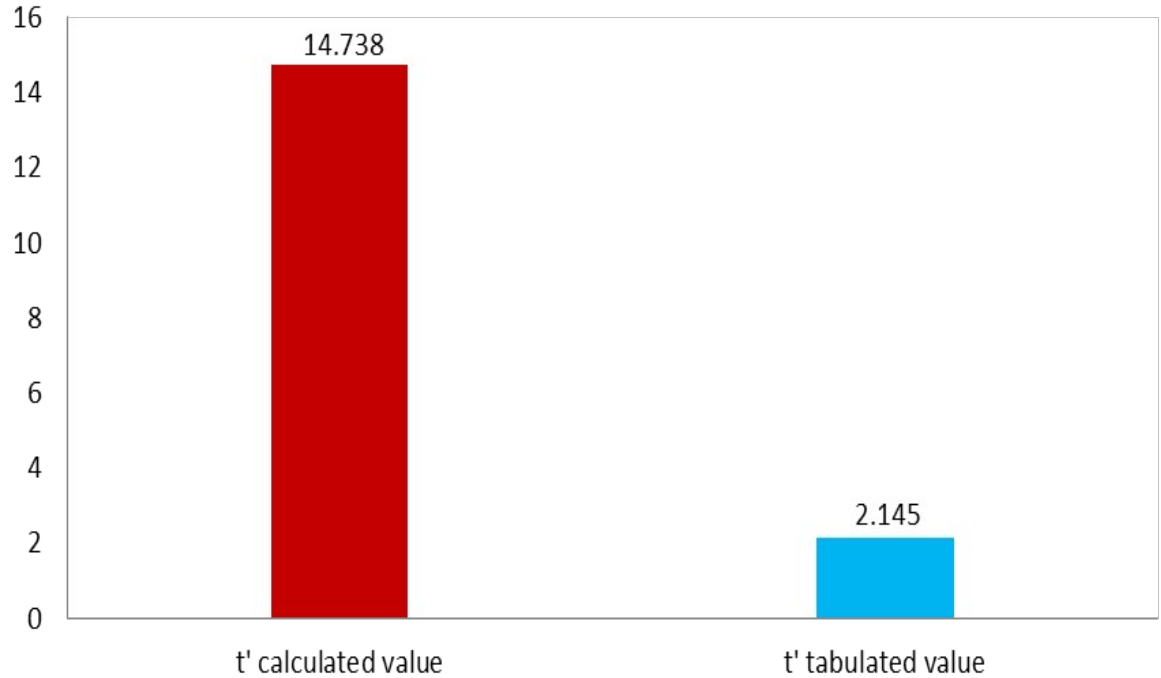
versus post test of group B was 14.738, which was greater than the tabulated paired 't' value ie, 2.145 for (n-1) degrees of freedom at 5% level of significance. This proved that there was a statistical significant difference in between pre versus post test results. The pre test mean was 4.667 and the post test mean was 1.0, which showed that there was reduction in VAS score in post test values, that shows the recovery of selected samples in response to intervention.

### VAS score of Group B



**Graph -3**

**Paired 't' calculated and 't' tabulated value - Group B ( VAS score)**



**Graph - 4**

**Table 5**

Table 5 represents the comparative mean values, mean differences, standard deviation and unpaired 't' calculated value between group A and group B on VAS score.

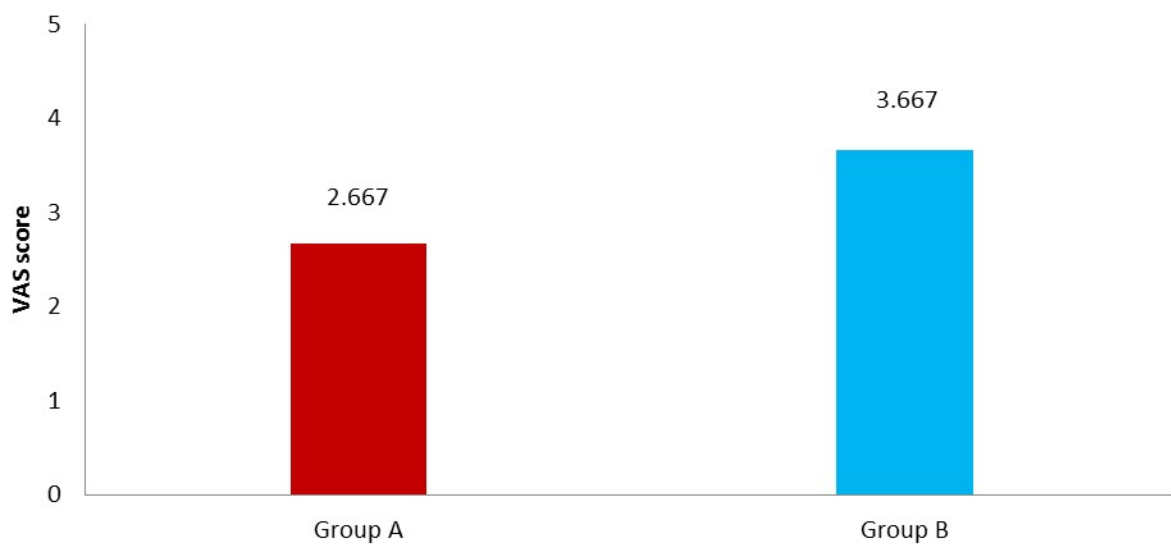
VAS score	Mean	Mean difference	Standard deviation	Unpaired 't' calculated value
Group A	2.667	1.00	.893	3.07
Group B	3.667			

Table 5 shows the analysis of group A and Group B with VAS scores: - the

unpaired 't' calculated value of 3.07 was greater than the tabulated unpaired 't' value of 2.048 at 0.05 level of significance, which showed that there was a statistically difference between group A and group B. The mean of group A was 2.667 and group B was 3.667, which showed that there was a greater improvement in group B than group A.

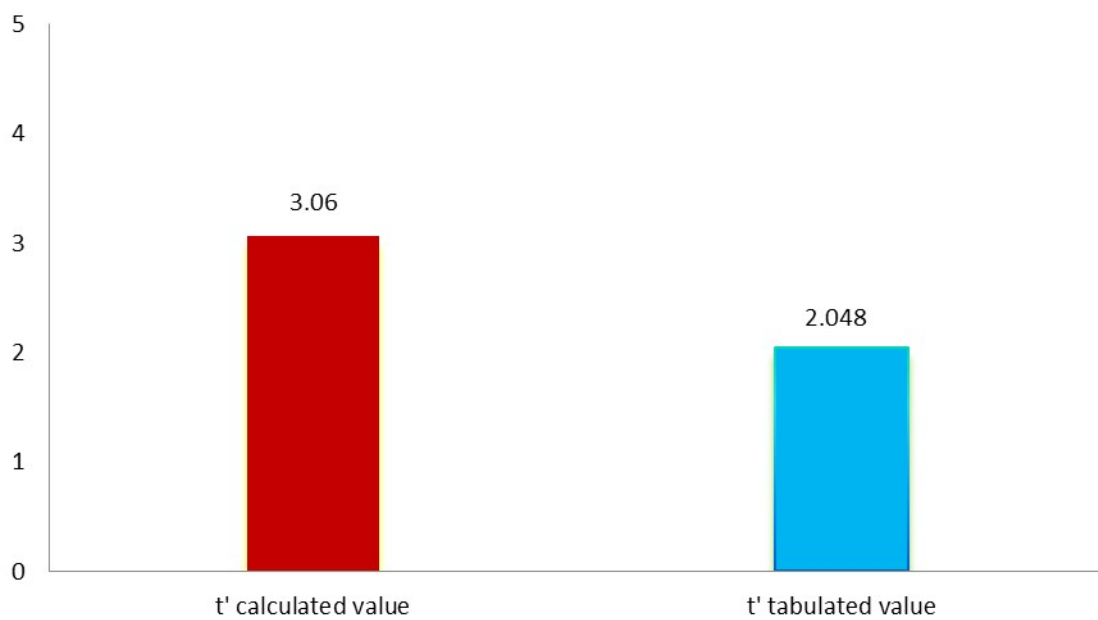
Therefore the study is rejecting the null hypothesis and accepting the alternate hypothesis.

#### **Mean difference of Group A and Group B – VAS score**



**Graph – 5**

**Unpaired ‘t’ calculated and ‘t’ tabulated value- VAS score**



**Graph-6**

**Table 6**

### **Experimental Group A**

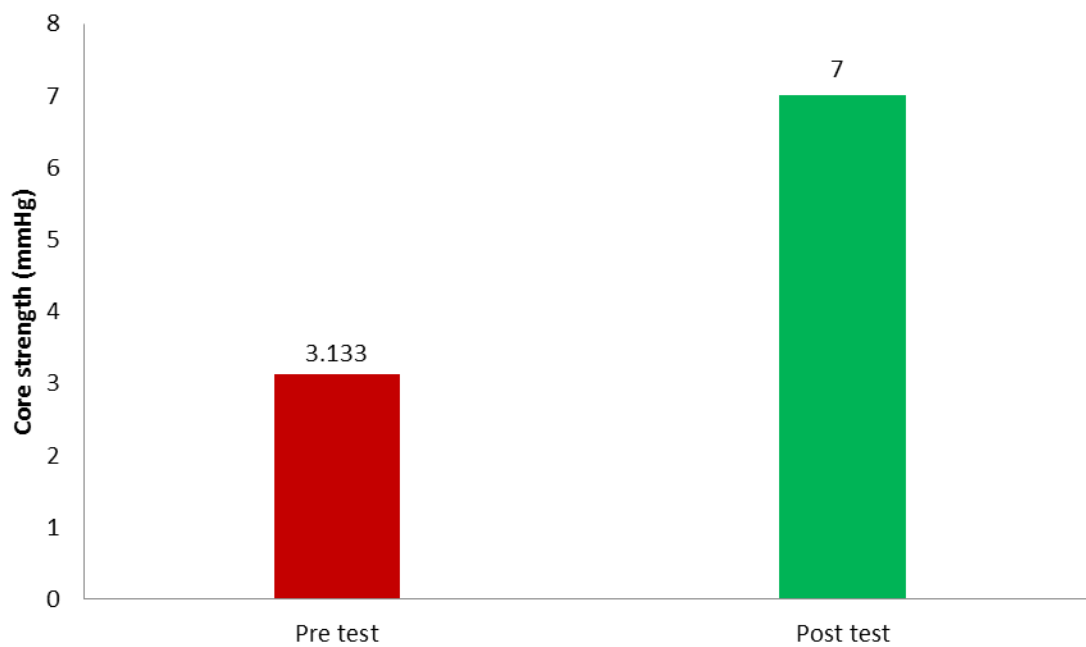
Table 6 represents the mean values, mean difference, standard deviation, and paired 't' calculated value between pre and post test values of prone abdominal drawing in test by Pressure Biofeedback Unit score for group A, who have been subjected to conventional training.

<b>Core strength score</b>	<b>Mean</b>	<b>Mean difference</b>	<b>Standard deviation</b>	<b>Paired 't' calculated value</b>
Pre test	3.133	3.867	1.9952	7.5050
Post test	7			

Table 6 shows the analysis of core strength score:- The paired 't' calculated value of pre versus post test session of group A was 7.5050 which was greater than the tabulated paired 't' value of 2.145 for (n-1) degrees of freedom at 5% level of significance. This proved that there was a statistical significant difference between pre and post test scores. The pre test mean was 3.133 and the post test mean was 7 and the mean difference was 3.867, which showed that there was an increase in core strength score in post test session, that shows the improvement in core strength for selected subjects in response to the intervention (conventional programme)

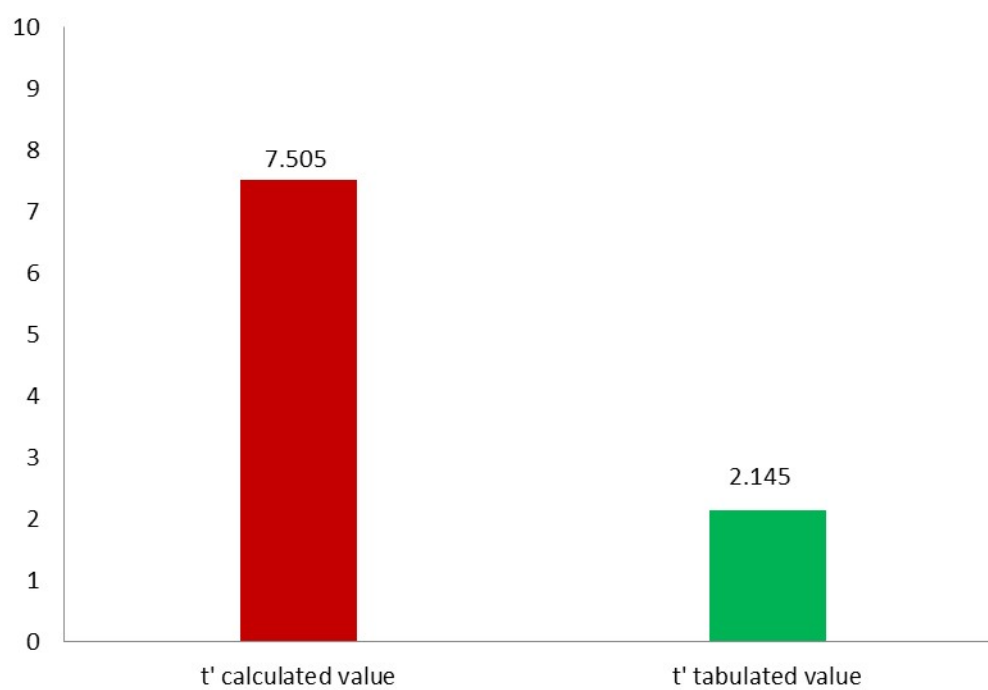
### **Core strength score of Group A**





**Graph 7**

**Paired 't' calculated and 't' tabulated value- Group A (Core strength score)**



**Graph 8**

**Table 7**

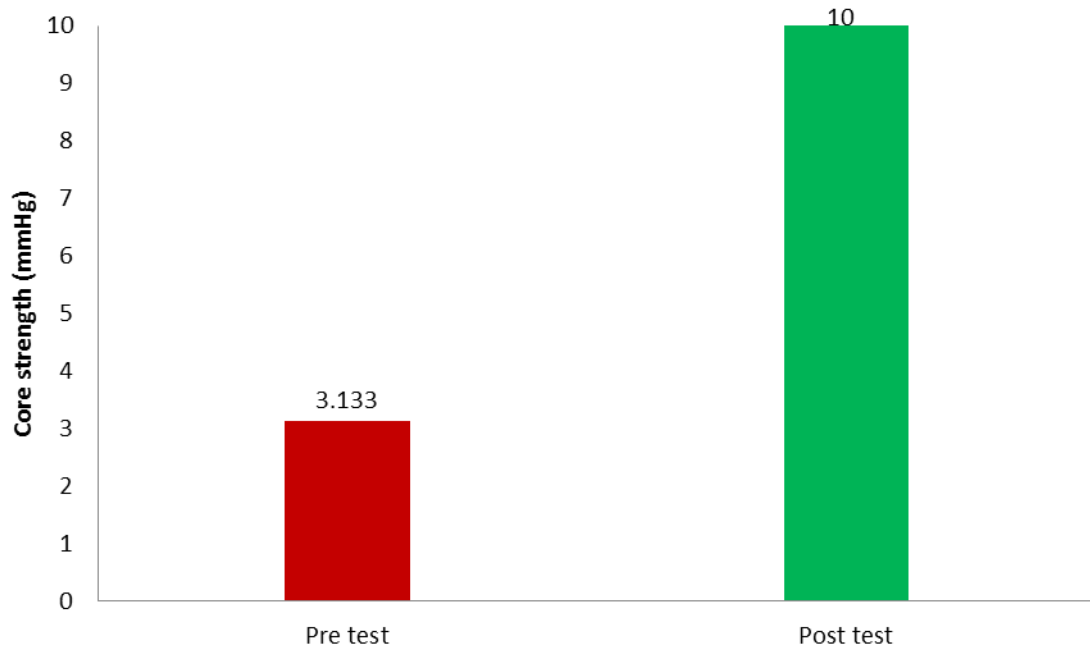
### Experimental Group B

Table 7 represents the mean values, mean difference, standard deviation and paired 't' calculated value between pre versus post test values of prone abdominal drawing in test by Pressure Biofeedback Unit score for group B, who have been subjected to pilates training.

<b>Core strength score</b>	<b>Mean</b>	<b>Mean difference</b>	<b>Standard deviation</b>	<b>Paired 't' calculated value</b>
Pre test	3.133	6.867	1.974	13.471
Post test	10			

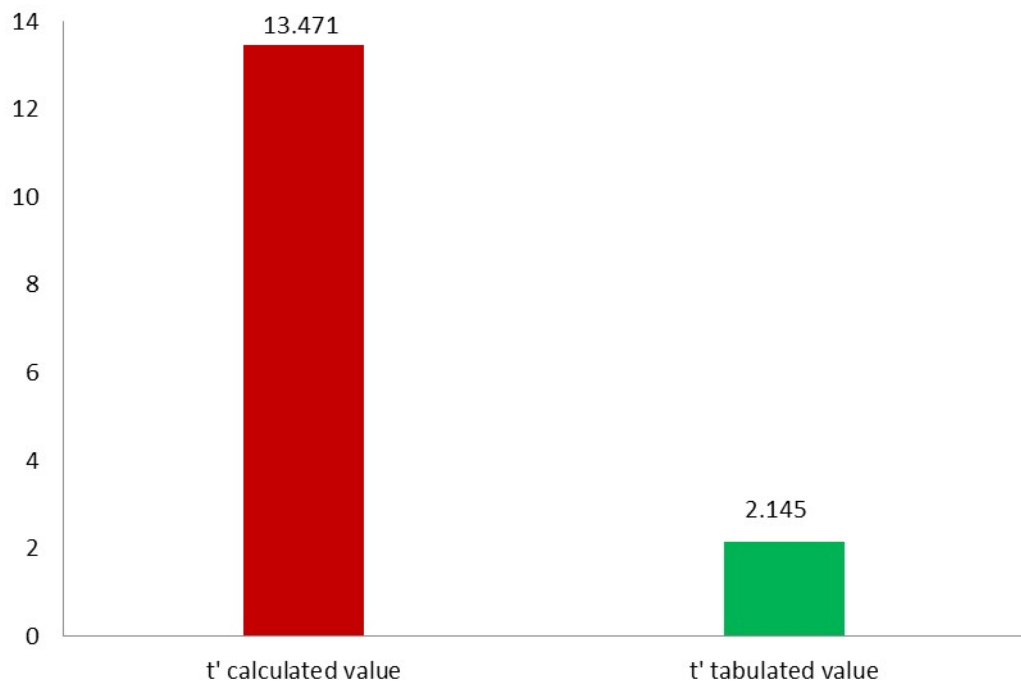
Table 7 represents the analysis of core strength :- the paired 't' calculated value of pre versus post session of group B was 13.471, which was greater than the paired 't' tabulated value ie, 2.145 for (n-1) degrees of freedom at 5% level of significance. This proved that there was a statistical significant difference in between pre and post test values. The pre test mean was 3.133 and the post test mean was 10 and the mean difference was 6.867, which showed that there was an increase in core strength score in post test values, that shows the improvement in core stability of selected subjects in response to intervention (pilates).

### Core strength score of Group B



**Graph 9**

**Paired 't' calculated and 't' tabulated value- Group B (Core strength score)**



**Gra**

**ph 10**

**Table 8**

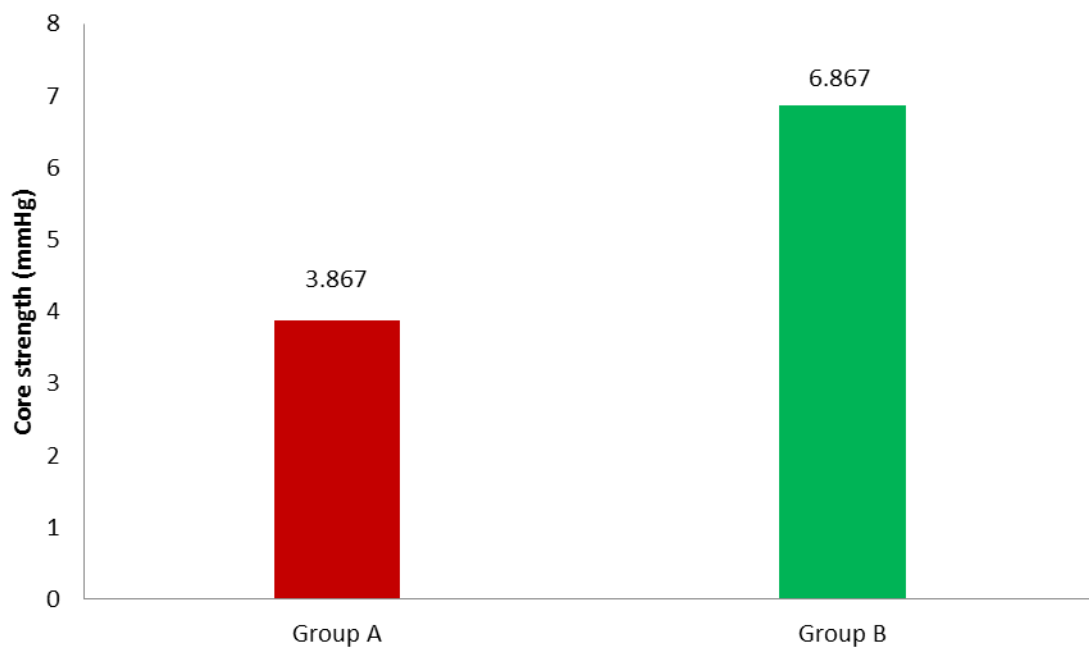
Table 8 represents the comparative mean values, mean difference, standard deviation and unpaired 't' calculated value between group A and group B on prone abdominal drawing in test score.

<b>Core strength score</b>	<b>Mean</b>	<b>Mean difference</b>	<b>Standard deviation</b>	<b>Unpaired 't' calculated value</b>
Group A	3.867	3.00	1.468	6.88
Group B	6.867			

Table 8 shows the analysis of group A and group B with Prone abdominal drawing in test score:- the unpaired 't' calculated value is 6.867, which was greater than the tabulated unpaired 't' value ie, 2.048 at 0.05 level of significance, which showed there was a statistically significant difference between group A and group B. The mean value of group A was 3.867 and the group B was 6.867, which showed that there was a greater improvement in group B than group A.

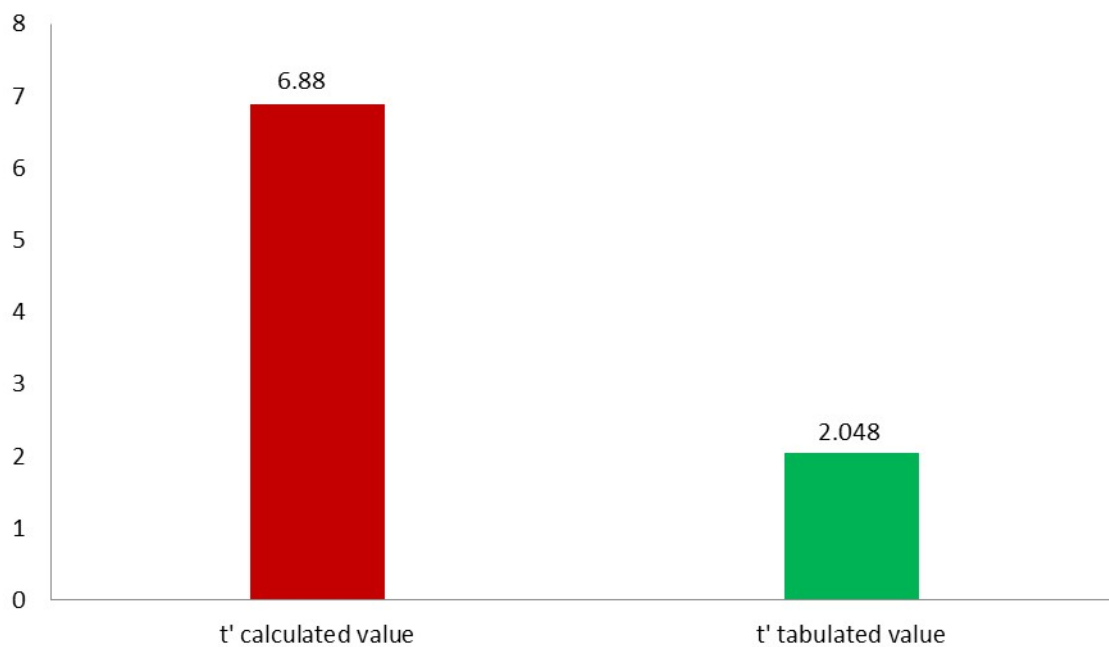
Therefore, the study is rejecting the null hypothesis and accepting the alternate hypothesis.

#### **Mean difference of Group A and Group B – Core strength score**



**Graph 11**

**Unpaired 't' calculated and 't' tabulated value – Core strength score**



**Graph 12**

## **5. RESULTS AND DISCUSSION**

The aim of the study was to compare the efficacy of conventional exercises versus pilates training to relieve pain and improve core strength in patients with lordotic postural LBP.

Lacote et al (1987) suggested that the abdominal drawing in test assessed by visually observing a depression in the abdominal wall when cued to bring the stomach towards spine has also been noted as a standard muscle test for the transversus abdominis, in addition, Richardson, Hodges, Jull (1996) suggested in their study that prone abdominal drawing in test performed with an inflatable pressurized pad was shown to be just as effective in differentiating between those suffering from back pain and those subjects reporting no back pain with the use of fine –wire EMG and also found that pressure changes recorded on a pressure sensor during the prone abdominal drawing in test are not related to the superficial muscles of the abdominal wall, are more likely measures of the contraction of the transversus abdominis. Harrison and Wright (2000) confirmed the results of Hodges et al (1996) concluding that inflatable pressurized pad to assess transversus abdominis strength may be considered a useful measurement tool.

Boonstra, Anne.M, Schiphorst Preuper (2008) conducted a study to determine the reliability and validity of VAS in chronic musculoskeletal pain aged over 18 years. The study population consisted of 52 patients in the reliability study and 344 patients in the validity study. The conclusion of the study was that the reliability of VAS is moderate to good. Based on the results of above mentioned studies VAS and Prone abdominal drawing in test were taken as parameters of the present study.

30 patients completed participation in the 8 week study. The subjects ranged in

age from 40 to 45 years. All subjects were physically active. None of the participants were experiencing joint or musculoskeletal pain at the time of study.

All the subjects were assessed with VAS for pain and prone abdominal drawing in test by Pressure Biofeedback Unit for core strength on the first day. The same were repeated after successfully completing the exercise protocol by 8 weeks. The results shows that the pre test VAS score for conventional training ranged from 3 to 6 and post test score ranged from 0 to 4. The pre test VAS score for pilates ranging from 3 to 6 and post test score ranging from 0 to 3. The difference in mean between pre and post test for conventional training was 2.667 and for Pilates is 3.667, in which pilates trained group was greater than the conventionally trained group.

The pre test value of core strength ranging from 0 to 6 mmHg and post test score ranging from 4-12mmHg for conventionally trained group, and 0 to 6 mmHg and 7 to 12 mmHg were the pre and post test values of pilates trained group respectively. The difference in mean between pre and post test was 3.867 for conventional trained group and 6.867 for pilates trained group, in which mean difference of pilates trained group was greater than conventional trained group.

The results shows there is a significant difference between conventional trained group and pilates trained group after 8 weeks, suggesting pilates training had a more efficient outcome on pain relief and core strength. Thus the null hypothesis, which states there is no significant difference in pain and core strength between the conventionally trained group and pilates trained group in the performed test, is rejected and accepted the alternate hypothesis.

## **6. SUMMARY AND CONCLUSION**

This study focuses on pain relief and on improving segmental stability especially transverse abdominis and assessed improvements in pain and function of deep stabilizers at the conclusion of 8 weeks training programme.

To conduct the study, 30 number of patients were selected by non-convenient sampling method after the consideration of inclusion and exclusion criteria. The informed consent were obtained from the subjects individually. The training consists of 30-40 minutes of work out, 5 times a week and was progressive pattern of exercise. The VAS and Prone abdominal drawing in test by Pressure Biofeedback Unit were taken as parameters to measure pain and core stability respectively. The tests were performed prior to the training and after 8 weeks treatment. All scores were recorded as absolute values, for e.g.:- 'subjective indication of 4 cm' in VAS was recorded as a score of '4'. At the same time, 'a pressure drop of 6 mmHg' in Pressure Biofeedback Unit was recorded as a score of '6' and trial which resulted in a 'rise of pressure' due to failure to isolate and contract the transverse abdominis resulted in a score of '0'. The mean and standard deviation of the pretest and post test scores were calculated for each group. The paired 't' test was used to compare the pre and post test values of group A and group B separately. The unpaired 't' test was used to compare the mean difference between group A and group B.

In the analysis and interpretation of VAS, the unpaired 't' calculated test value was 3.06 was greater than the tabulated 't' value of 2.048 at 0.05 level of significance, which showed that there was a statistically significant difference between group A and group B. The mean value of group A was 2.667 and group B was 3.667 with a mean difference of 1, which showed that there was statistically significant improvement in pain



in Group B when compared to Group A in response to treatment.

In the analysis and interpretation of prone abdominal drawing in test by pressure biofeedback unit, the unpaired 't' test value of 6.88 was greater than the tabulated 't' value of 2.048 at 0.05 level of significance, which showed that there was a statistically significant difference between group A and group B. The mean value of group A was 3.867 and group B was 6.867. The mean difference was 3, which showed that there was a statistically significant improvement in core strength in group B when compared to group A in response to treatment.

### **Conclusion**

Based on the results, it is concluded that 8 weeks of pilates training or conventional exercises significantly relieves the pain and improve the core strength, but pilates is more effective than conventional training.

## **7. LIMITATIONS AND RECOMMENDATIONS**

## Limitations

- Larger sample size could have brought in more clarity in observed trends.
- A difficulty in exact contraction of transverse abdominis muscle.
- Only transverse abdominis function could be tested, which is one of the important lumbar stabilizer, which help to prevent recurrence of LBP..

## Recommendations

The scopes of future studies regarding this topic are

- The same study can be carried out in a larger population.
- The study can be carried out in males.
- Similar study can be conducted in other age groups.
- The study can be conducted using other measurement tools for the evaluation of pain, for e.g. Mc Gill Questionnaire.
- The study can be done to find out the efficacy of pilates in improving flexibility of spine through the parameters such as back performance scale or schober's test.
- Similar study can be done in other postural back pain syndromes such as sway back or kyphotic postures.
- The study can be carried out in athletes or in subjects with asymptomatic lordotic posture.
- Similar study can be carried out in a group of subjects with acute LBP

## 8. BIBLIOGRAPHY

SL NO	AUTHOR	BOOK NAME	PUBLICATION	EDITION
1	Sandie	Pilates for Core strengthening	Greenwich	1 <sup>st</sup> edition (2005)
2	Susan Hollenberg	Pilates	SuzanneScott	1 <sup>st</sup> edition (2002)
3	AlyceaUngaro	Everyday Pilates	Dorling	1 <sup>st</sup> edition

			Kindersley	(2008)
4	Carolyn Kisner	Therapeutic Exercise- Foundations and Techniques	FADavis company,	5 <sup>th</sup> edition (2007)
5	John.V.Basmajian	Therapeutic Exercises	Williams and Wilkims	5 <sup>th</sup> edition (1993)
6	Carry. M .Hall	Therapeutic Exercises Moving Towards Function	Lippincott Williams and Wilkims	3 <sup>rd</sup> edition (1998)
7	Lance. T. Twomey	Physical therapy and Low back	Churchill Livingston,	2 <sup>nd</sup> edition (1994)
8	Jean Oliver	Back Care	Butterworth Heinemann	1 <sup>st</sup> edition (1994)
9	S.BrentBrotzman	Clinical Orthopaedic Rehabilitation	Mosby PuBlication	1 <sup>st</sup> edition (2002)
10	Edinberg	Grieve's Modern Manual Therapy of the Vertebral column	Churchill Livingstone	2 <sup>nd</sup> edition (1994)
11	Kendall and Kendall	Muscle Testing and Function	Williams and Wilkims	4 <sup>th</sup> edition (1993)
12	Cynthya.C.Norkins	Joint Structure and Function- A Comprehensive Analysis	Jay Pee Brothers	4 <sup>th</sup> edition (2006)
13	Andry Vleeming	Movement stability and Low back pain	Churchill Livingstone	1 <sup>st</sup> edition (1997)
14	The lumbar spine and back pain	Malcolm I.V Jayson	Churchill Livingstone	4 <sup>th</sup> edition (1992)
15	Back pain – Recognition and management	M.A Hutson	Butterworth Heinemann	1 <sup>st</sup> edition (1993)

## **ANNEXURE- I**

### **REHABILITATION PROTOCOL**

#### **PILATES**

**Aim of the pilates in patients with lordotic postural low back pain**

- To strengthen transverse abdominis, other abdominal muscles and gluteus maximus and medius.
- To increase segmental control of the spine.
- To reduce increased lumbar lordosis and increase mobility.
- To lengthen hip flexors.
- To stretch back extensors.
- To achieve maximum core stability.
- To correct spinal alignment.

The 8 weeks programme was taught in a progressive manner and the modifications were given when necessary to the individual subjects. The table below details the exercises introduced during training.

<b>SL No:</b>	<b>Exercises (1-4 Weeks)</b>	<b>Repetitions/ session</b>	<b>Objectives</b>
<b>1.</b>	Supine sit position	10 repetitions/ session	➤ To establish good spinal alignment.
<b>2.</b>	Pelvic tilt	10 repetitions	➤ To increase mobility in the lumbar spine and to strengthen the core stability muscles
<b>3.</b>	Knee drop	5 times each leg	➤ To strengthen core stabilizers by moving the legs and to mobilize the hip.
<b>4.</b>	Hamstring stretch	5 times each leg	➤ To lengthen the hamstrings and to develop core strength and trunk stability.
<b>5.</b>	Shoulder bridge	Start with 5 and progress to 10 repetitions	➤ To establish segmental control of the spine, to increase mobility, to develop core strength and to lengthen hip flexors
<b>6.</b>	Abdominal preparation	Start with 5, built upto 10.	➤ To strengthen the transverse abdominis and also to strengthen the core muscles.
<b>7.</b>	Seated 'c' curve	Start with 5, built upto 10.	➤ To strengthen the abdominals and to develop core strength.
<b>8.</b>	Seated spine twist	Start with a few to begin and progress to 5 on each side	➤ To mobilize the spine in rotation while maintaining stability and strength. It also improves trunk stability

<b>SL No:</b>	<b>Exercises (1-4weeks)</b>	<b>Repetitions/ session</b>	<b>Objectives</b>
<b>9.</b>	Roll down and roller	10 repetitions	➤ To strengthen abdominals and spine muscles during flexion and mobilize the spine segmentally
<b>10.</b>	Cat pedals	Start with 5 on each hand, built upto 10.	➤ To strengthen all trunk stabilizers and develop core strength, to increase the bone load (increase the density of the bones of the upper body),to develop balance and strengthen the spinal extensors.
<b>11.</b>	Shell stretch	Start with 5, built upto 10.	➤ To stretch and relieves back extensors.
<b>12.</b>	Cat's tail	Start with 5 and progress upto 10.	➤ To strengthen all trunk stabilizers, to develop core strength, to increase bone load of the upper body and to strengthen the spinal extensors.
<b>13.</b>	Hip flexor stretch	3 times on each leg, progress towards 5.	➤ To lengthen hip flexors.
<b>14.</b>	Monkey squat	Start with 5 and progress to 10.	➤ To develop good lifting skills and strengthen the trunk stabilizers.

<b>SL No:</b>	<b>Exercises (4-8 weeks)</b>	<b>Repetitions/ session</b>	<b>Objectives</b>
<b>1.</b>	Hundred (knee flexed to extended)	Breathing in for 5 pumps and out for 5 pumps and continue till 100	➤ To strengthen deep abdominals and torso.
<b>2.</b>	Push ups (knee flexed to extended)	Start with 3 and built up to 6 times	➤ To strengthen the glutei and abdominals
<b>3.</b>	Teaser	5 repetitions	➤ To strengthen the abdominal muscles
<b>4.</b>	Saw	4 sets for a total of 8 repetitions	➤ To strengthen deep rotator
<b>5.</b>	Open leg rocker	3 rolls	➤ To strengthen deep core muscles
<b>6.</b>	Cork screw	Begin with 3 repetitions and progress to 5	➤ To strengthen deep core muscles
<b>7.</b>	Criss cross	Begin with 3 repetitions and progress to 5	➤ To strengthen deep core muscles

## CONVENTIONAL EXERCISES

### Specific stretching

<b>SL No:</b>	<b>Exercises (1-8weeks)</b>	<b>Hold time</b>	<b>Repetitions/ session</b>	<b>Objectives</b>
<b>1.</b>	Thomas stretch	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen hip flexors.
<b>2.</b>	Knee to chest	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen erector spinae.
<b>3.</b>	Side stretch	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen quadratus lumborum.
<b>4.</b>	Rectus Femoris stretch	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen rectus Femoris.
<b>5.</b>	Obers stretch	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen tensor fascia lata.
<b>6.</b>	Tendo Achilles stretch	Start with 5 seconds and progress up to 10 seconds	Start with 5 times and progress up to 10 times	To lengthen Gastrocnemius and soleus.

### Specific strengthening

<b>SL</b>	<b>Exercises (1-4 weeks)</b>	<b>Hold time</b>	<b>Repetitions/ Session</b>	<b>Objectives</b>
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<b>No:</b>				
<b>1.</b>	a) Posterior pelvic tilt (knee flexed) b) Progress to knee extended	5 sec, progress to 10 sec.	10 repetitions	Strengthen transverse abdominis and external oblique.
<b>2.</b>	a) Posterior pelvic tilt and single leg sliding b) Progress to double leg slide	5 sec, progress to 10 sec.	10 repetitions	Strengthen transverse abdominis and external oblique.
<b>3.</b>	Trunk curl	5 sec, progress to 10 sec.	10 repetitions	Strengthen rectus abdominis.
<b>4.</b>	a) Trunk curl with rotation up to scapular level (knee flexed) b) Progress to knee extended	5 sec, progress to 10 sec.	10 repetitions	Strengthen both obliques.
<b>5.</b>	Bend leg fall out	5 sec, progress to 10 sec.	10 repetitions	Basic stabilization of abdominal muscle
<b>SL No:</b>	<b>Exercises (1-4 weeks)</b>	<b>Hold time</b>	<b>Repetitions/ Session</b>	<b>Objectives</b>
<b>6.</b>	Modified bicycle	-	10 repetitions	Improves abdominal co-ordination
<b>7.</b>	Alternate arm and	-	10 repetitions	Improves abdominal co-ordination

	leg rise in supine			
<b>8.</b>	a) Quadripod leg extension b) Progress to alternate leg and arm raise	5 sec, progress to 10 sec.	5 progress to 10	To improve gluteal strength and to improve core stability.
<b>9.</b>	Bridging	5 sec, progress to 10 sec.	5 progress to 10	To improve glutei strength and to lengthen flexors.

<b>SL No:</b>	<b>Exercises (4-8 weeks)</b>	<b>Hold time</b>	<b>Repetitions/ Session</b>	<b>Objectives</b>
<b>1.</b>	a) Straight leg lowering ( $70^{\circ}$ ) b) Progress to less than $20^{\circ}$	5 Sec, progress to 10 sec	5, progress to 10.	To strengthen tranverseabdominis and obliques.
<b>2.</b>	Trunk curl in knee extension	5 Sec, progress to 10 sec	5, progress to 10.	To strengthen rectus abdominis.

3.	Trunk curl with rotation (elbow to opposite knee)	5 Sec, progress to 10 sec	5, progress to 10.	To strengthen both obliques
4.	Spine – pull down against theraband	5 Sec, progress to 10 sec	5, progress to 10.	To improve abdominal stabilisation.
5.	Upright pull against theraband and drawing in	5 Sec, progress to 10 sec	5, progress to 10.	To improve abdominal stabilisation.
6.	Alternate arm and leg rise on physio ball	5 Sec, progress to 10 sec	5, progress to 10.	Improve co-ordination of abdominals
7.	Quadripod alternate arm and leg rise with resistance(wt cuff)	5 Sec, progress to 10 sec	5, progress to 10.	To strengthen glutei and improves core strength
8.	Bridging alternate arm and leg raise	5 Sec, progress to 10 sec	5, progress to 10.	Core muscle activation and glutei strengthening
<b>SL No:</b>	<b>Exercises (4-8 weeks)</b>	<b>Hold time</b>	<b>Repetitions/ Session</b>	<b>Objectives</b>
9.	Bridging with leg movement	5 Sec, progress to 10 sec	5, progress to 10.	To improve abdominal control.
10.	Pelvic lift	5 Sec, progress to 10 sec	5, progress to 10.	To improve abdominal strength.
11.	Trunk curl up on physio ball	5 Sec, progress to 10 sec	5, progress to 10.	To strengthen rectus abdominis and obliques.



## **ANNEXURE - II**

### **ASSESSMENT FORMAT**

#### Subjective assessment

- Name
- Age
- Sex
- Occupation
- Chief complaints
- History of illness
  - a) Present history
  - b) Past medical history
  - c) Personal history
- Associated medical problems
- Pain assessment
  - Duration
  - Onset
  - Frequency
  - Nature of pain
  - Aggravating factors
  - Relieving factors
  - Intensity

- Vital signs
- Temperature
- Blood pressure
- Pulse rate
- Respiratory rate

## **Objective assessment**

### **On observation**

- Built of patient
- Posture
- Gait
- Structural abnormality

### **On palpation**

- Tenderness around low back region
- Spasm

### **On examination**

- Sensory examination
- Nerve tension tests
- Motor examination
- Deep tendon reflex examination
- Plumb line assessment
- Muscle length examination
- Individual trunk muscle strength examination

## **Investigations**

- X ray
  - Lumbo sacral angle (lateral view)
  - Curvature of the lumbar spine (lateral view)

## **Special tests**

## **Differential diagnosis**

## **Management**

- Aims
- Means
- Follow up

## **ANNEXURE- III**

## **PATIENT CONSENT FORM**

I \_\_\_\_\_ voluntarily consent to participate in the research named

**“A COMPARATIVE STUDY ON THE EFFICACY OF CONVENTIONAL EXERCISES VERSUS PILATES IN IMPROVING CORE STRENGTH ON LORDOTIC POSTURAL LOW BACK PAIN”**

The researcher has explained me the treatment approach in brief, risk of participation and has answered the questions related to the study to my satisfaction.

Signature of Participant :

Signature of the Witness :

Signature of Researcher :

Date :

Place :

**Lateral view of x- ray in upright position**



